Assessing Stream Resources in Wisconsin Using Probabilistic Sampling

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Presentation Overview

I   Environmental Setting (Past / Present)

II   Program Data Needs

III Monitoring Strategy, Sampling Designs, and Field Measures

IV Opportunities and Challenges

Wisconsin's Aquatic Resources

Perennial Streams:	22,000
"Coldwater" Streams:	2,100
Streams and Rivers (miles):	43,000
Lakes:	15,000
Great Lakes Shoreline (miles):	1,000
Mississippi River Shoreline (miles):	230
Wetlands (acres):	5,000,000

Wisconsin's Aquatic Resources

Perennial Streams:	22,000
"Coldwater" Streams:	2,100
Streams and Rivers (miles):	43,000

I) Environmental Setting:
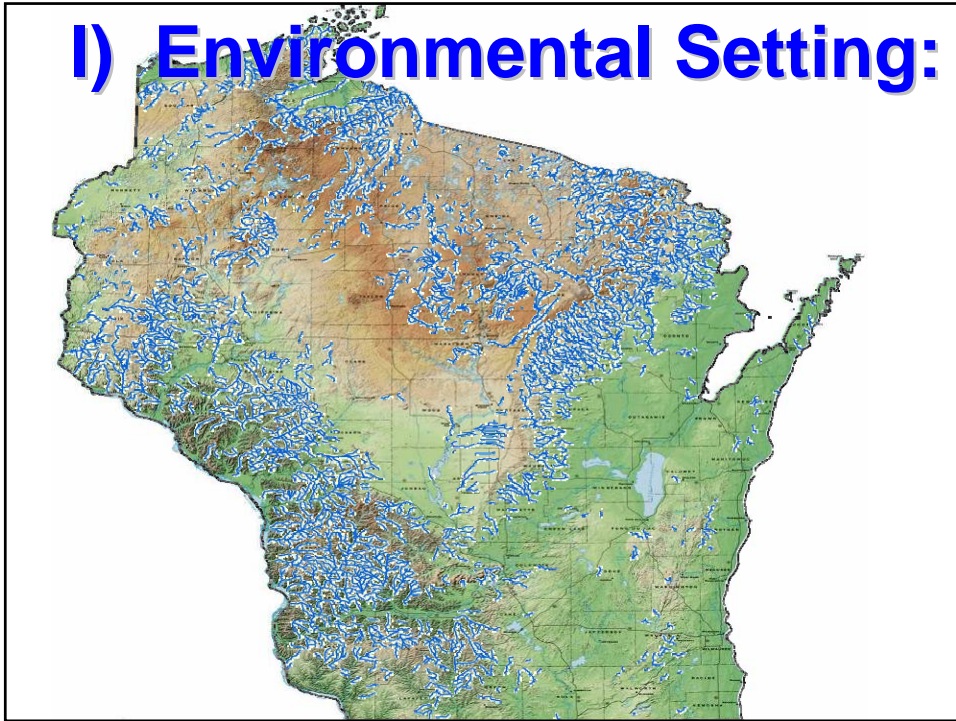
Legacy Land Use Impacts

"The streams of the Midwest have undoubtedly changed much in character since the country has become so thickly settled. I have been informed that many streams, formerly deep and narrow, and abounding in pickerel, bass, and catfishes, have grown wide and shallow, while the water in them varies greatly in different seasons, and they are inhabited by bullheads, suckers, and a few minnows."
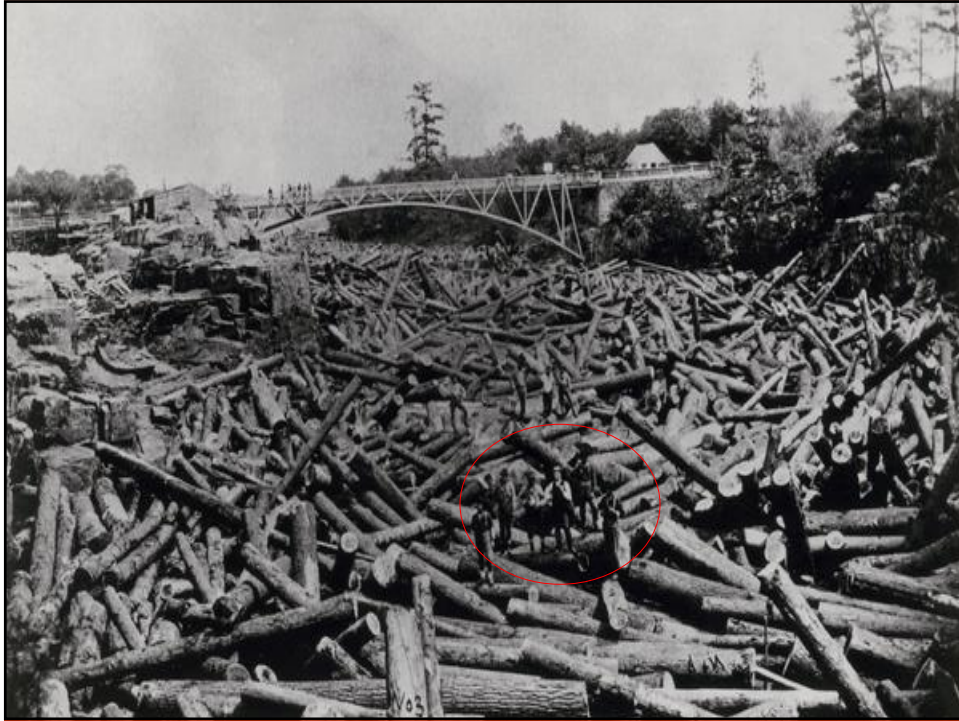
Seth Meek, 1892

Wisconsin 1860s

Wisconsin Clear-cut by 1910s

Current Land Use Impacts

- Primarily agricultural
- Increasingly urbanization

Sedimentation
Cropland soil erosion estimated loss rate of 4 tons / acre / yr.

Nutrients
One dairy cow produces 150 lbs. of manure per day
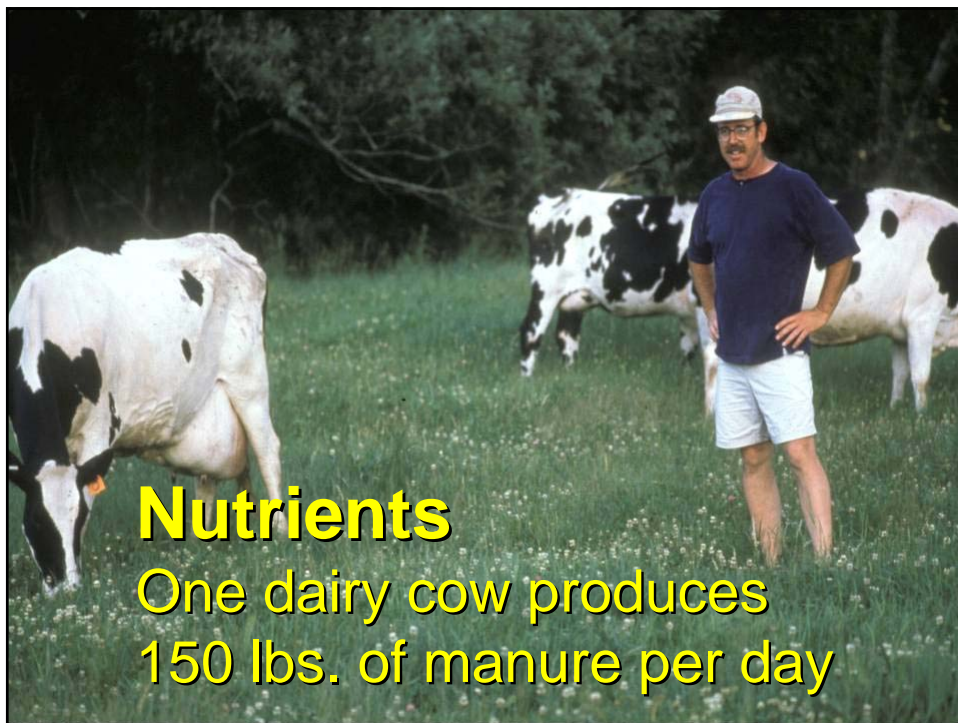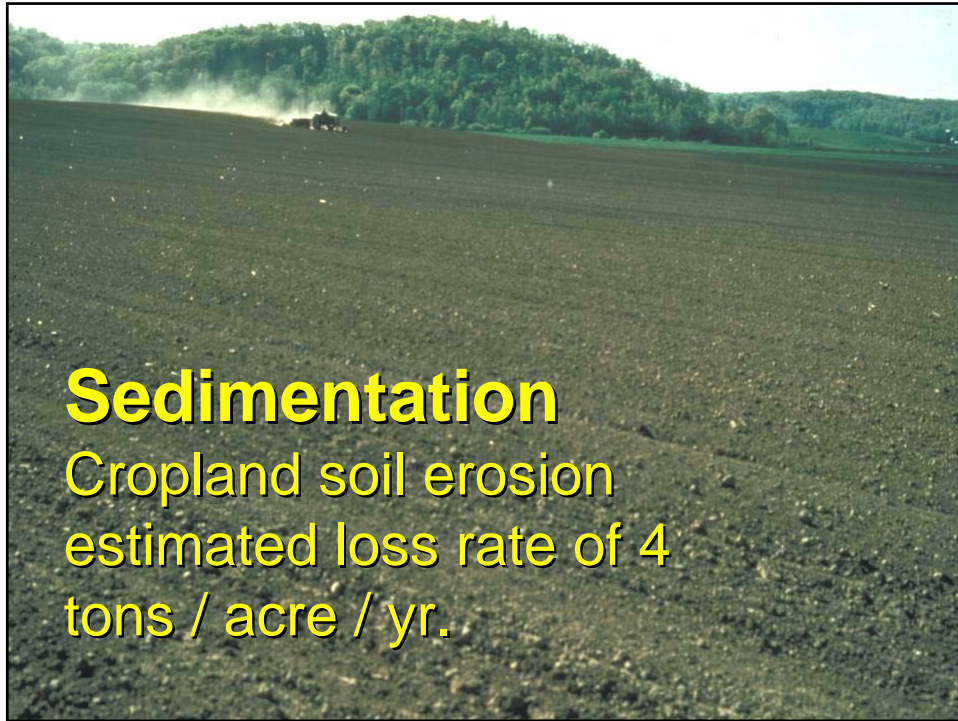
Wisconsin's 1.2 million dairy cows produce 65 billion lbs. manure / yr.

Eutrophication

Pesticides (corn)
Herbicides: 6,010,000 lbs. / yr.
Insecticides: 79,000 lbs. / yr.

Urbanization
Hydrologic alterations

Wisconsin Land Cover
LANDSAT 1991 – 1993

Urban / Developed:
High Intensity
Low Intensity
Golf Course

Agriculture:
General Agriculture
Cranberry Bog

Grassland

Forest:
Coniferous
Broad-leaved Deciduous
Mixed Deciduous/Coniferous

Open Water

Wetland:
Emergent / Wet Meadow
Lowland Shrub
Forested

II) Agency Data Needs

Responsible for both Environmental Quality and Natural Resource Management

WDNR Monitoring Strategy Tiered Approach

- **Tier 1:** Probabilistic broad-scale status & trends

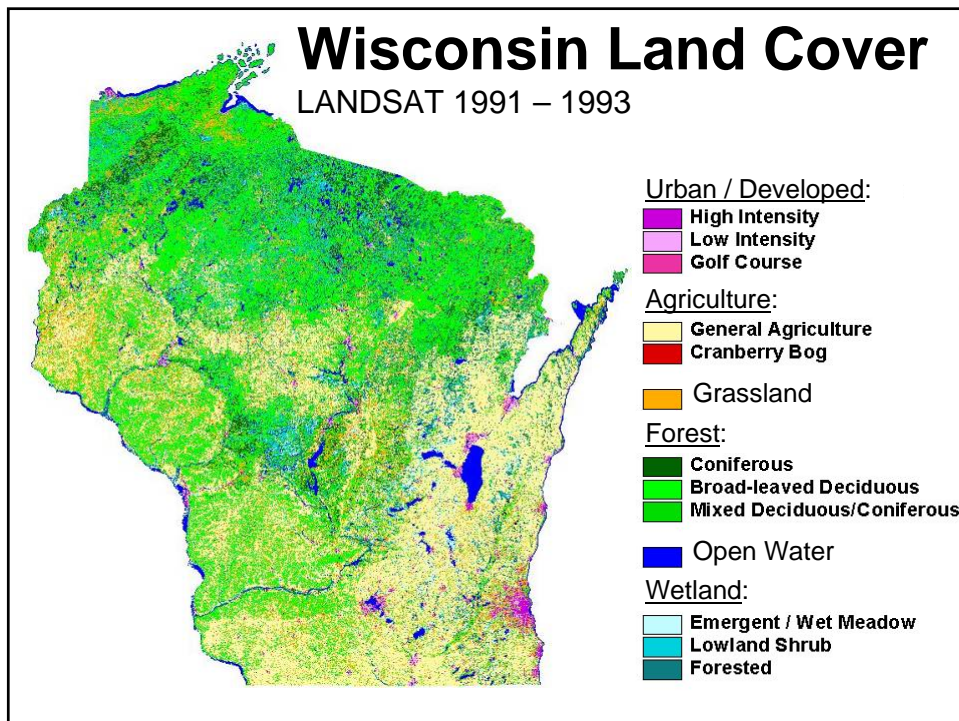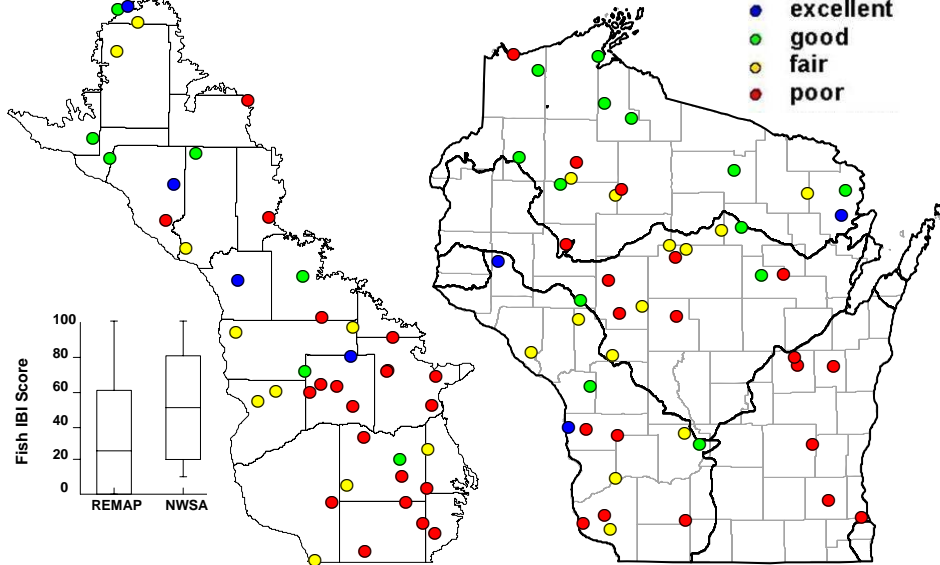- **Tier 2:** Targeted stream-specific assessment / problem identification

- **Tier 3:** Targeted program or management evaluation (e.g. before-after studies)
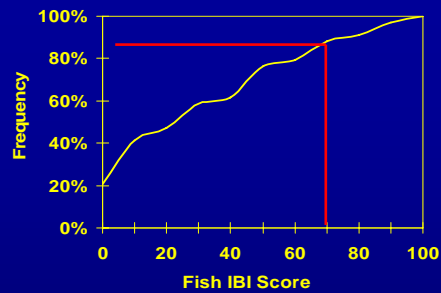
Tier 1 Probabilistic Studies
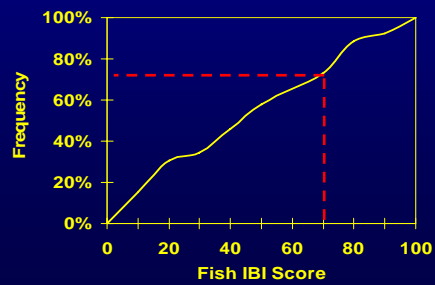WI-REMAP and NWSA

Fish IBI Ratings
- excellent
- good
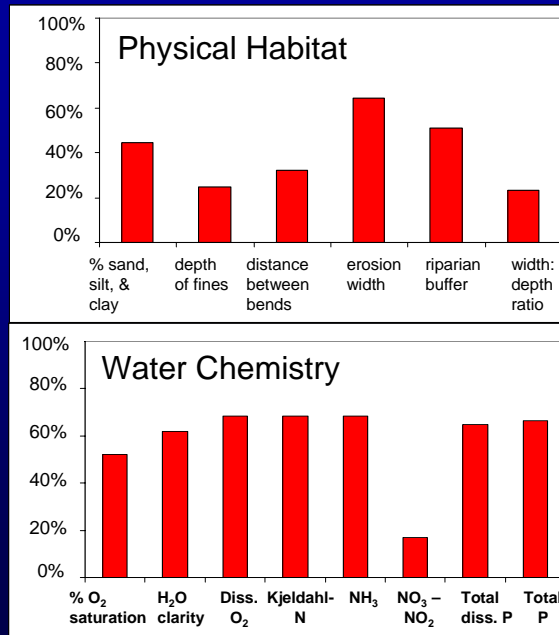- fair
- poor

REMAP Fish IBI Scores

NWSA Stream Fish IBI Scores

Estimated percent of stream miles NOT meeting reference condition threshold values:

Physical Habitat

(Bar chart, Y-axis 0% to 100%)
- % sand, silt, & clay: ~44%
- depth of fines: ~24%
- distance between bends: ~32%
- erosion width: ~65%
- riparian buffer: ~51%
- width: depth ratio: ~23%

Water Chemistry

(Bar chart, Y-axis 0% to 100%)
- % O_2 saturation: ~52%
- H_2O clarity: ~62%
- Diss. O_2: ~68%
- Kjeldahl-N: ~68%
- NH_3: ~68%
- $NO_3 - NO_2$: ~16%
- Total diss. P: ~64%
- Total P: ~66%

Quantify the Relative Risk That Various Stressors Pose to Biota

(Horizontal bar chart)

Scores > 1 Significant Risk to Biota

- Bank erosion
- Riparian buffer
- % sand, silt, & clay sediment
- depth of fines
- Total dissolved phosphorus
- Total phosphorus
- Kjeldahl nitrogen
- Ammonia
- Dissolved oxygen
- % oxygen saturation
- Water clarity

X-axis: 0.0, 1.0, 2.0, 3.0, 4.0, 5.0

Relative Risk of Poor HBI Conditions
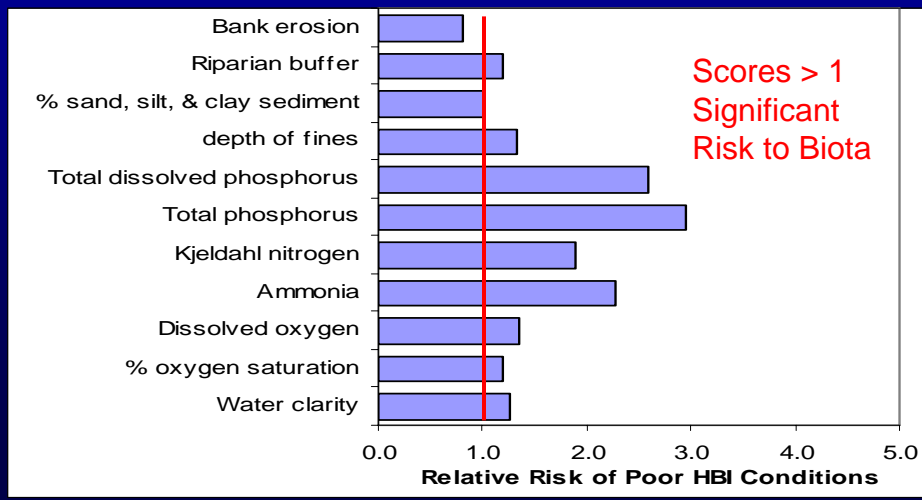
2007 Probabilistic Stream Sampling

1. Assess Streams Statewide & Ecoregionally
2. Begin Reference Conditions Development
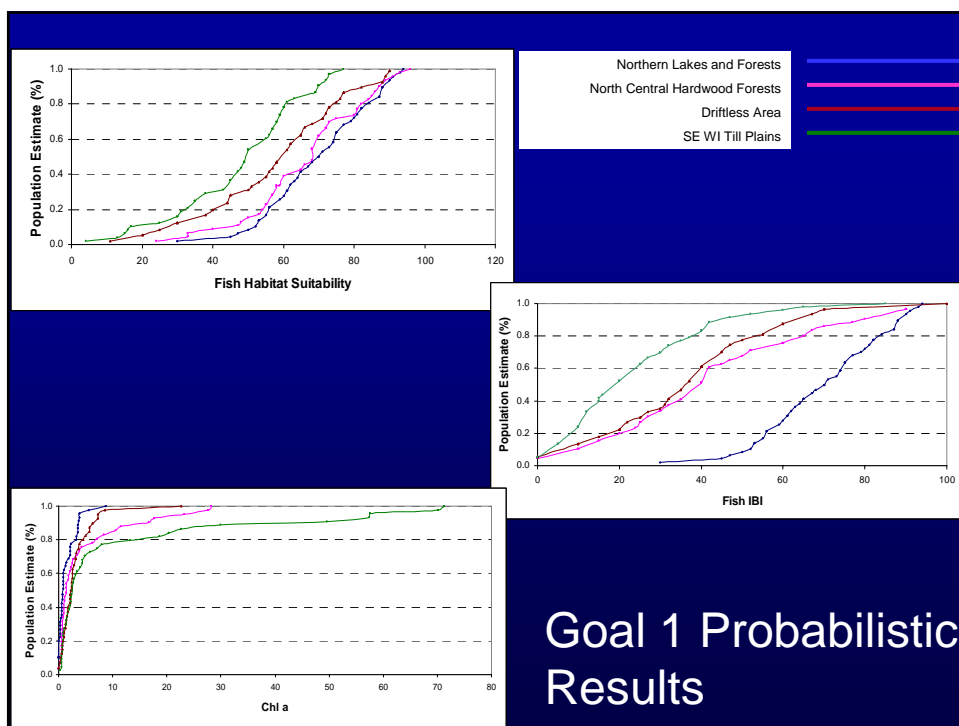3. Evaluate Validity of Road-access Sampling
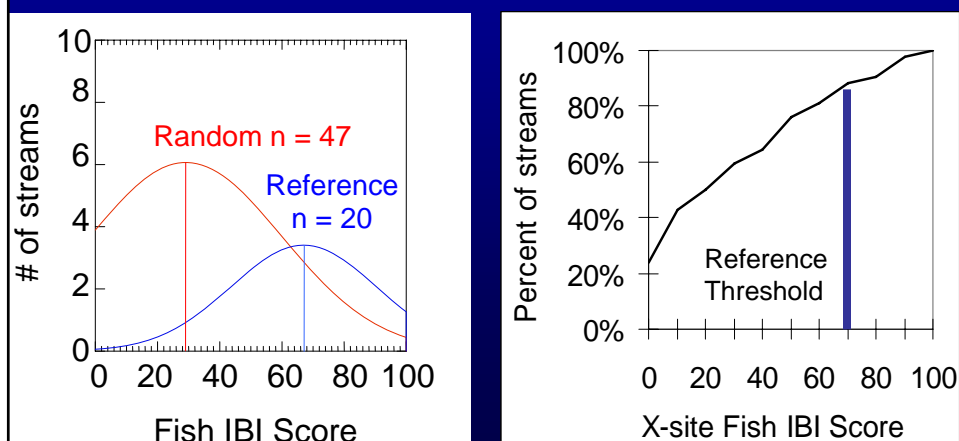4. Evaluate Utility of Qualitative Habitat Data

2007 CWA Accomplishments

Sample Type	Target #	Sampled
Random	200	194 (97%)
Reference	48	35 (73%)
Rd. – Rand. (prs.)	24	27 (113%)
Qual. Habitat	~ 40	78 (195%)

Goal 1 Probabilistic Results

Legend (top right):
- Northern Lakes and Forests
- North Central Hardwood Forests
- Driftless Area
- SE WI Till Plains

Chart 1 (top left): X-axis: Fish Habitat Suitability (0–120), Y-axis: Population Estimate (%) (0.0–1.0)

Chart 2 (middle right): X-axis: Fish IBI (0–100), Y-axis: Population Estimate (%) (0.0–1.0)

Chart 3 (lower left): X-axis: Chl a (0–80), Y-axis: Population Estimate (%) (0.0–1.0)

Goal #2
Develop Objective Expectations of Stream Health From Reference Cond.

Chart (bottom left): Y-axis: # of streams (0–10), X-axis: Fish IBI Score (0–100)
- Random n = 47
- Reference n = 20

Chart (bottom right): Y-axis: Percent of streams (0%–100%), X-axis: X-site Fish IBI Score (0–100)
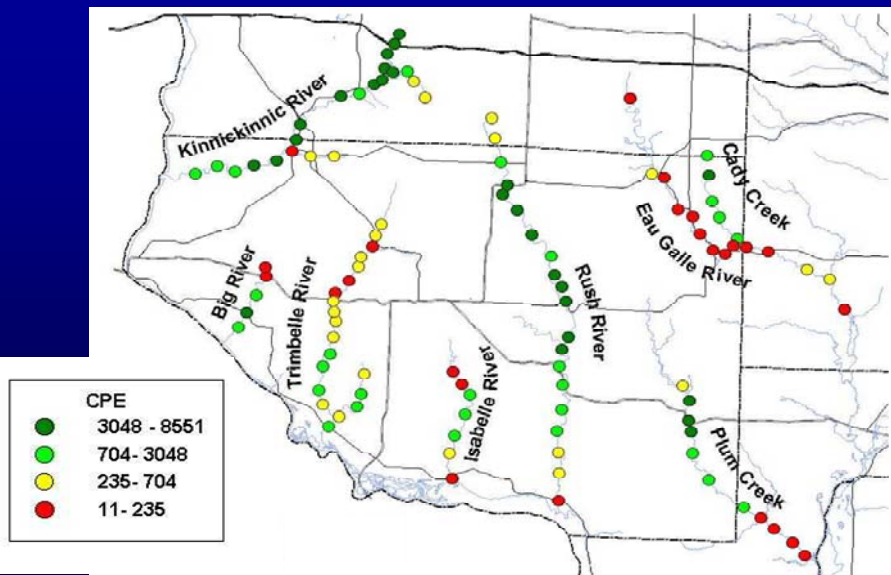- Reference Threshold

Goal #3 Can We Sample near bridges?

A Critically Important Question When Making Inferences from Small Sample Surveys
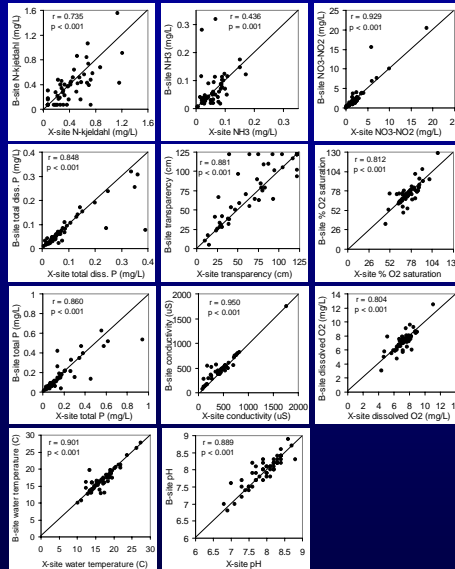
Tier 2 Example: targeted trout surveys

Tier 3 Example: Management Evaluation

Elk Creek, Vernon Co., WI (Before)

Elk Creek (during channel rehab)

Opportunities and Challenges

- Identifying and prioritizing EQ and NR data needs
- Balancing local and statewide data needs
- Setting expectations
- Determining DQOs and MQOs
- QA and QC Issues
- Emerging Threats
  - Global warming
  - Exotics
  - Disease
  –

Summary:

- Geology, and historic and current land use has a significant influence on the distribution and quality of Wisconsin's stream resources.

- Wisconsin DNR has made good progress in moving from BPJ to more scientifically – rigorous resource monitoring and assessment.

- The Department needs to continue to refine Program data needs and priorities to improve its science – driven management.

- Refinement of Program-specific data quality and data quantity objectives will also help improve efforts.

Questions?